

What is claimed is:
CLAIMS.

1. (Amended) A method of obtaining an image of a boundary of an object, said boundary representing a refractive index variation, said method including:
- 5 irradiating said boundary with penetrating radiation having high lateral spatial coherence and a propagation component transverse to said refractive index variation; and receiving at least a portion of said radiation on an image plane so as to form said image, said radiation having been refracted by said boundary such that said boundary is represented on said image by a corresponding intensity variation in said image.
- 10 2. (Amended) A method as claimed in claim 1, including separating the boundary and said image plane by a distance to enhance the contrast of said intensity variation.
3. A method as claimed in claim 2, wherein said distance is greater than or equal to
- 15 0.3 m.
4. A method as claimed in claim 2, wherein said distance is greater than or equal to 0.7 m.
- 20 5. A method as claimed in claim 1, wherein the extent of refraction of said radiation depends on the length said refractive index variation is maintained at said boundary in the direction of said propagation component.
6. A method as claimed in claim 1, wherein said radiation is x-ray radiation having
- 25 energy in the range 1 keV to 1 MeV.
7. A method as claimed in claim 1, wherein said radiation is polychromatic x-ray radiation.
- 30 8. A method as claimed in claim 1, including generating said radiation with a source less than or equal to 20 μ m in diameter.

9. ~~A method as claimed in claim 1, wherein said intensity variation is sharp and localised.~~

10. (Amended) An apparatus for obtaining an image of a boundary of an object, said
5 boundary representing a refractive index variation, said apparatus including:

a source for irradiating said boundary with penetrating radiation having high lateral spatial coherence and a propagation component transverse to said refractive index variation; and

a detector for receiving at least a portion of said radiation so as to form said image,
10 said radiation having been refracted by said boundary such that said boundary is represented on said image by a corresponding intensity variation in said image.

11. (Amended) An apparatus as claimed in claim 10, including having a separation
15 distance between said boundary and said detector to enhance the contrast of said intensity variation.

12. An apparatus as claimed in claim 11, wherein said distance is greater than or equal to 0.3 m.

20 13. An apparatus as claimed in claim 11, wherein said distance is greater than or equal to 0.7 m.

14. An apparatus as claimed in claim 10, wherein the extent of refraction of said radiation depends on the length said refractive index variation is maintained at said
25 boundary in the direction of said propagation component.

15. An apparatus as claimed in claim 10, wherein said source generates x-ray radiation with energy in the range 1 keV to 1 MeV.

30 16. An apparatus as claimed in claim 10, wherein said source generates polychromatic x-ray radiation.

17. ~~An apparatus as claimed in claim 10, wherein said source has a diameter less than or equal to 20 μm .~~
18. An apparatus as claimed in claim 10, wherein said intensity variation is sharp and
5 localised.
19. (Amended) A method of deriving a phase-contrast record of an internal boundary representing a sharp refractive index variation, comprising:
irradiating the boundary with penetrating radiation having a propagation direction
10 such that there is a significant component of the propagation vector transverse to the direction of said refractive index variation, and further having a lateral spatial coherence sufficiently high for the variation in refractive index to cause a detectable change in the local direction of propagation of the radiation wavefront at the boundary; and
detecting and recording at least a portion of said radiation after it has traversed
15 said boundary in a manner whereby an effect of said change in the local direction of propagation is observable and thereby recorded as a local diminution or rapid variation of intensity of the radiation which thereby substantially images or detects the boundary.
20. A method as claimed in claim 19, wherein said radiation is polychromatic x-ray
20 radiation.
21. A method as claimed in claim 19, wherein said radiation is x-ray radiation having energy in the range 1 keV to 1 MeV.
22. A method as claimed in claim 19, including irradiating said boundary with a
25 source of x-rays having a diameter less than or equal to 20 μm .
23. (Amended) A method as claimed in claim 19, including separating said boundary and the position of detecting said portion of said radiation by a distance which enhances
30 the contrast and/or resolution of the part of an image comprising the record of said local diminution or rapid variation of intensity.

24. A method as claimed in claim 23, wherein said distance is greater than or equal to 0.3 m.

25. A method as claimed in claim 23, wherein said distance is greater than or equal to 0.7 m.

26. (Amended) An apparatus for deriving a phase-contrast record of an internal boundary representing a sharp refractive index variation, comprising:

means to irradiate the boundary with x-ray radiation having a propagation direction such that there is a significant component of the propagation vector transverse to the direction of said refractive index variation, and further having a lateral spatial coherence sufficiently high for the variation in refractive index to cause a detectable change in the local direction of propagation of the radiation wavefront at the boundary; and

means to detect and record at least a portion of said radiation after it has traversed said boundary in a manner whereby an effect of said change in the local direction of propagation is observable and thereby recorded as a local diminution or rapid variation of intensity of the radiation which thereby substantially images or detects the boundary.

27. An apparatus as claimed in claim 26, wherein said radiation is polychromatic x-ray radiation.

28. An apparatus as claimed in claim 26, wherein said radiation is x-ray radiation having energy in the range 1 keV to 1 MeV.

29. An apparatus as claimed in claim 26, wherein said means to irradiate is a source of x-rays having a diameter less than or equal to 20 μm .

30. (Amended) An apparatus as claimed in claim 26, wherein said boundary and the position of detecting said portion of said radiation are separated by a distance which enhances the contrast and/or resolution for part of an image comprising the record of said

local diminution or rapid variation of intensity.

31. An apparatus as claimed in claim 30, wherein said distance is greater than or equal to 0.3 m.

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32. An apparatus as claimed in claim 30, wherein said distance is greater than or equal to 0.7 m.

33. (Amended) A method of obtaining an image of a boundary of an object, said
10 boundary representing a refractive index variation, said method including:

irradiating said boundary with penetrating radiation having high lateral spatial coherence and a propagation component transverse to said refractive index variation; and

receiving at least a portion of said radiation on an image plane so as to form said image, said radiation having been Fresnel diffracted by said boundary such that said
15 boundary is represented on said image by a corresponding intensity variation in said image.

34. (Amended) An apparatus for obtaining an image of a boundary of an object, said boundary representing a refractive index variation, said apparatus including:

20 a source for irradiating said boundary with penetrating radiation having high lateral spatial coherence and a propagation component transverse to said refractive index variation; and

a detector for receiving at least a portion of said radiation so as to form said image, said radiation having been Fresnel diffracted by said boundary such that said boundary
25 is represented on said image by a corresponding intensity variation in said image.

35. (Deleted)

36. (Deleted)

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37. (Deleted)

38. A method of determining the phase of an image, including processing an image jobtained using a method as claimed in any one of claims 1 to 9 or 19 to 23.

39. A method of determining the phase of an image as claimed in claim 38, wherein said processing is based on Maxwell's equations for electromagnetic radiation.

40. A method of determining the phase of an image as claimed in claim 39, wherein said equations are the transport of intensity equations.

41. (New) A method as claimed in claim 1, wherein said radiation is generated by and provided from a source to said boundary without Bragg diffraction.

42. (New) An apparatus as claimed in claim 10, wherein said radiation is generated by and provided from a source to said boundary without Bragg diffraction.

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